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MINI REVIEW

Antenatal Hydronephrosis

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Early detection of many fetal abnormalities is now possible due to the availability of antenatal ultrasound screening in the 12th to 16th week of gestation. Regarding urinary tract anomalies, most can be detected at 18–20 weeks of gestation. The incidence of antenatal hydronephrosis is 0.6–4.5%, and it makes up about 92% of antenatally-detected urinary tract anomalies. If antenatal hydronephrosis is detected, the patient should be carefully followed-up in order to identify the associated congenital anomaly. Usually, if the renal pelvic diameter exceeds 5 mm in the second trimester, then fetal ultrasonography should be repeated in the third trimester. Renal pelvic diameter greater then 7 mm is often related to a significant congenital anomaly; therefore, a plan for management after birth should be detailed. The newborn should be treated with prophylactic antibiotics and investigative imaging studies should be arranged accordingly.

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There are 2 CME questions based on this article

1. Introduction

The term antenatal hydronephrosis, fetal hydronephrosis or prenatal hydronephrosis refers to dilatation of the renal pelvis collecting system, which is a common finding on antenatal ultrasound examinations in 0.6–4.5% of pregnancies.[1] Differences in reported data may be due to different criteria used to define the disorder and the level of attention paid to the urinary system by the ultrasonographer.[2–7] It is bilateral in 20–40% of cases,[8] and occurs approximately twice as often in males than in females. About 3 million maternal ultrasounds in the United States are performed annually, with hydronephrosis being the most commonly detected anomaly. As the routine use of maternal ultrasound has become more prevalent, urologists and pediatricians are increasingly being informed about possible kidney defects before birth. Urinary tract anomalies can be detected as early as the 12th to 14th week of gestation.[9] On the other hand, they may not be detected until later in infancy or childhood when symptoms of urinary tract infection or obstruction develop.

The majority of fetuses found to have renal pelvic dilatation are in a transient physiologic state; the anomaly is not clinically significant and usually resolves spontaneously. However, obstruction or reflux can prevent normal renal development and lead to progressive deterioration of renal function in some cases. The goal of antenatal ultrasound screening and postnatal management is to detect these congenital anomalies that may otherwise impact the health of the infant and that require further evaluation and possible intervention to improve outcomes.

2. Definition and Grading

The diagnostic criteria are still controversial. Several systems have been developed to grade the severity of antenatal hydronephrosis.

2.1. Society for Fetal Urology

The Society for Fetal Urology[10] uses a grading system (grades 0–4) based on the degree of pelvic dilation, presence of caliceal dilation, and the presence and severity of parenchymal thinning or atrophy, as listed in Table 1.

2.2. Anterior–posterior diameter

The anterior–posterior diameter (APD) of the renal pelvis is the most common classification for reporting antenatal hydronephrosis. It is based on the measurement of the maximum anteroposterior diameter of the renal pelvis, or the renal pelvic diameter and gestational age.[11] Although there is a lack of consensus on the threshold of APD that defines the severity of antenatal hydronephrosis, most experts now agree that hydronephrosis is clinically significant when APD exceeds 5 mm before 24 weeks of gestation or exceeds 7 mm beyond 25 weeks of gestation.[2,12–16] The grading system according to the APD is shown in Table 2.

3. Differential Diagnoses

The differential diagnoses of fetal hydronephrosis include physiologic hydronephrosis, ureteropelvic junction obstruction, ureterovesical pathology, and bladder outlet obstruction (Table 3).[17]

Table 1 Society for Fetal Urology (SFU) grading system for infant hydronephrosis

Grade	Pattern of renal sinus splitting
0	No splitting
I	Urine in pelvis barely splits sinus
II	Urine fills intrarenal pelvis
III	SFU Grade 2 and minor calyces uniformly dilated and parenchyma preserved
IV	SFU Grade 3 and parenchyma thin

Table 2 Anterior–posterior diameter (APD) grading system for fetal hydronephrosis and association with postnatal pathology

APD during second trimester (mm)	APD during third trimester (mm)	Grading of antenatal hydronephrosis	% with postnatal pathology
≤7	≤9	Mild	12
7–10	9–15	Moderate	45
>10	>15	Severe	88

4. Management

Postnatal evaluation includes detailed physical examination and the use of radiological studies to detect urinary tract abnormalities such as obstructive uropathy or vesicoureteral reflux (VUR).

Currently, there is no single test or finding that can accurately differentiate between infants with significant disease and those who are normal or have insignificant findings. In general, most experts recommend the use of an algorithm based on the presence of predictive factors such as bilateral involvement or severity of hydronephrosis for postnatal management that limits unnecessary radiographic studies and minimizes parental distress.

4.1. Physical examination

At birth, a complete physical examination of the newborn can detect abnormalities that suggest genitourinary abnormalities (Table 4).

4.2. Imaging studies

Postnatal radiological evaluation of a newborn with antenatal hydronephrosis begins with an ultrasound

Table 3 Differential diagnoses of antegrade hydronephrosis

Differential diagnosis of antenatal hydronephrosis	%
Transient hydronephrosis	48
Physiologic hydronephrosis	15
Ureteropelvic junction obstruction	11
Vesicoureteral reflux	4
Megaureter, obstructed or non-obstructed	4
Multicystic kidney	2
Ureterocele	2
Posterior urethral valves	1
Other problems to be considered	
Renal cystic disease	
Megacalicosis	
Retrocaval ureter	
Midureteral stricture	
Ectopic ureter	
Prune belly syndrome	
Urethral atresia	
Anterior urethral valves	
Cloacal abnormality	
Hydrocolpos	
Urachal cyst	
Ovarian cyst	
Bowel duplication	
Duodenal atresia	
Anterior meningocele	
Pelvic tumor	
Ureteral polyp	

Table 4 Physical examination of the newborn

Finding	May indicate…
Abdominal mass	Enlarged kidney due to pelviureteric junction obstruction or multicystic dysplastic kidneys
Palpable bladder or poor urine stream and dribbling	Posterior urethral valves in a male infant
Deficient abdominal wall with undescended testes	Prune belly syndrome
Abnormalities in the spine and lower limbs or patulous anus	Neurogenic bladder

examination. The timing of ultrasonography and the need for other studies depend on the severity of postnatal hydronephrosis and whether there is unilateral or bilateral renal involvement.

4.2.1. Ultrasonography

The timing of the study depends on the severity of antenatal hydronephrosis. Ultrasound examination of the kidneys and bladder is usually performed 48 hours after birth. In general, the examination should be avoided in the first 2 days after birth as hydronephrosis may not be detected because of physiologic volume depletion and relative oligouria. However, infants with bilateral hydronephrosis and those with a severe solitary hydronephrotic kidney require urgent evaluation on the 1st postnatal day. Ultrasound examination should be repeated 3 months later if the initial postnatal ultrasound is normal or shows only mild hydronephrosis.

4.2.2. Voiding cystourethrogram

A voiding cystourethrogram (VCUG) is performed to detect VUR and to evaluate the posterior urethra in boys. If hydronephrosis is present on the postnatal ultrasound, then VCUG should be performed, usually within 4 weeks in the majority of cases.[18,19] However, it must be obtained within 48 hours of birth in any infant suspected to have posterior urethral valve or bladder outlet obstruction. Furthermore, VCUG is recommended in all patients with antenatal hydronephrosis, including those who experienced resolution of hydronephrosis at birth, because 14% of infants will still have VUR[20] and 45% will have urinary tract abnormalities.[21]

4.2.3. Diuretic renography

Diuretic renography is used to diagnose urinary tract obstruction in infants with persistent hydronephrosis, and is usually ordered after a VCUG has demonstrated no VUR.[17] It is relatively noninvasive, performed at 4–6 weeks of age, and gives quantitative data on function and drainage. The radionuclide of choice, which is injected intravenously, is ^{99m}technetium mercaptoacetyltriglycine (MAG 3) due to its high initial renal uptake, although ^{99m}technetium diethyltriamine pentaacetic acid (DTPA) may also be used. The split renal function is assessed quantitatively and is useful as a baseline study. A differential function of less than 40%, or greater than a 5% decrease on serial studies, may be an indication for surgical repair. Other authors use values less than 35% or even as low as 25%. It is important to note that these calculations are very operator-dependent.

The washout curve indicates the extent of obstruction. In a dilated system, if washout occurs rapidly after diuretic administration (<15 minutes), then the system is not obstructed. The system is considered obstructed if washout is delayed beyond 20 minutes. If washout is between 15 and 20 minutes, then the study is indeterminate. In patients with unilateral hydronephrosis, if the normal non-hydronephrotic kidney and hydronephrotic kidney both have equal function, then conservative management without surgery is a safe option.

4.2.4. Intravenous urogram

The combination of renal ultrasound and diuretic renography has replaced intravenous urography as a technique to evaluate renal anatomy and function in infants. It may not reveal additional information in asymptomatic infants and has the risk of radiation exposure.

4.3. Prophylactic antibiotics

The role of prophylactic antibiotics in children with antenatal hydronephrosis remains controversial. Higher rates of urinary tract infections have been reported in children with prenatally diagnosed hydronephrosis compared to the general pediatric population.[22] While it is believed that prophylactic antibiotics will prevent urinary tract infections in children with VUR, it has yet to be proven.[23] Common medications used for prophylaxis in neonates include amoxicillin[24] 50 mg/day and cephalexin[25] 50 mg/day. The antibiotics should be started after delivery until the diagnosis of VUR or obstructive uropathy has been excluded.

4.4. Surgical intervention

Prenatal intervention for fetuses with antenatal hydronephrosis is controversial and is limited by technical considerations. Although the first successful decompression

for antenatal hydronephrosis was achieved with open fetal surgery by creating bilateral cutaneous ureterostomies in a 21-week-old fetus,[26] the neonate did not survive due to pulmonary complications. Fetal cystoscopic ablation of posterior urethral valves,[27] and open and laparoscopic vesicostomies have also been described, but they were associated with high rates of complications.[28] Most fetal defects detected are best treated after birth. There is still a lack of data to show that fetal intervention improves postnatal outcomes. In utero surgical intervention should be weighed carefully against the risk of malformation caused by progressive damage to the fetus, leading to death or severe morbidity. In addition, it is still a challenge to obtain an accurate diagnosis with current technology, and the fetus who cannot wait to be corrected after birth usually has chromosomal or other major anomalies. The ethical issue should be discussed extensively before any decision is made, clinically or experimentally.

5. Conclusion

Antenatal hydronephrosis is a commonly made diagnosis and results in parental anxiety throughout the pregnancy. Careful communication with the parents and a detailed management strategy based on the findings of antenatal and postnatal ultrasound is mandatory. Use of an evidence-based protocol in each institution will lead to better understanding of the natural history of antenatal hydronephrosis and contribute to state-of-the-art management for this disease entity.

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